BURNER MODIFICATIONS- PRELIMINARY TEST RESULTS 1/23/92

Unit 2- Summary Burner Modifications:

Modifications (and their objectives) that were made to Unit 2's original B&W burners in the of Fall '91 are summarized below:

1. Installation of flame stabilizers in the inner zone on all 48 burners. Stabilizers were added to address burner overheat and mechanical deterioration. The objective was to significantly lower the maximum backplate temperature on the outer air registers.

2. Secondary air flow balancing through the burners was also conducted. Shrouding was added to the outer air registers to vary the restriction through each burner. Back plate settings were used to balance the inner air flows. The objective was to balance the inner and outer air flows through each burner to within +/- 5%. Perimeter loading around the burner (both inner and outer zones) was targeted for +/- 10%.

3. Burner register settings were changed to reduce the amount of overswirl in the outer air zone and to achieve an improved flame shape. The objective was to move the flame out away from the nozzle tip, reduce the occurrence of eyebrows and prevent recirculation of flue gases back into the burner.

4. Fuel flow balancing was also conducted which consisted of adding and changing coal line restrictors. Ten new restrictors were added and thirteen changes were made to orifice sizing on existing restrictors. These changes were made to improve fuel to air flow ratios in potentially rich or lean zones. The objective was to balance cold primary air flow to within +/- 3%.

Evaluation Restrictions:

The burner modifications made to Unit 2 are still being investigated and tested. Preliminary results are available, but a full test evaluation will not be completed for several months. An inspection evaluation won't be completed until the next available scheduled outage. Current restrictions on the evaluations are as follows:

1. Testing- Pulverizer 2H has not been available (since September 14, 1991) due to motor problems (rewound two times). Testing requires availability of all eight pulverizers, so that we can evaluate all eight combinations

of pulverizers at full load conditions. Evaluating all combinations allows us to evaluate worst case conditions. Without a spare motor, however, we must wait until H pulverizer motor becomes available.

2. Test Equipment- Not all the test equipment that has been ordered for AGASS testing, has been received. Some of the equipment that has been received, has had hardware problems.

3. Information- The RJM report, test results and recommendations based on the Air Distribution Analysis (ADA) has just been issued (**received 1/24/92,** a copy of the report is enclosed).

4. Manpower- Have more testing scheduled (reference schedule below) than available manpower. AGASS testing which is used to evaluate burner performance has been given the highest testing priority.

5. Unit 2 Outage- A scheduled maintenance outage is required on Unit 2 to evaluate the physical condition of the flame stabilizers. Earliest accurate inspections would be after six months of operation. A fireside inspection from the boiler platform will be required.

However, to implement any burner modifications on Unit 1's burners during the Spring '92 Outage, a decision must be made by the end of January 1992 to allow for fabrication and shipping of these components. Therefore, a preliminary evaluation of Unit 2's burner modifications has been conducted and is contained within.

Testing Schedule:

The current testing schedule on Unit 2 is as follows:

1. **AGASS** (automated gas analysis sampling system) testing for O2, CO and NOx levels is scheduled to begin February 3, 1992. AGASS testing will be used to determine distribution profiles at the economizer outlet. The schedule is awaiting pulverizer 2H and test rental equipment. After pulverizer 2H is back, Maintenance is requesting a week and half to get caught up on pulverizer inspections.

2. **Clean Air Flow Testing** is scheduled to determine how effective coal pipe restrictor changeouts have been and if additional changes are still needed.

3. **Cooling Air Flow Requirements Testing** is planned to determine optimum cooling air flow quantities across each burner row.

4. **Boiler Performance Testing (and Air Heater Testing)** with and without reduced cooling air flow requirements is also scheduled. An increase in boiler efficiency can be realized due to a reduction in cooling air requirements. Testing is scheduled to verify actual results.

5. **Pulverizer Fineness testing** (all pulverizers) is planned to correlate pulverizer condition with LOIs and performance.

PRELIMINARY TEST RESULTS- Unit 2 Burners

Preliminary test results on Unit 2 are based upon operational effects observed since the burner modifications have been implemented. Listed below are the factors used in the evaluation of these modifications:

1. Flame Shape and Pattern- Flame profiles are considerably improved and are quite different as compared to before the Outage and to flames on Unit 1. Flames have been pushed out 6" to 18" from the coal nozzle tip (burner front). Flame shapes are much more uniform with a good initial teardrop shape and bushy or flared tails.

Perimeter air loading around each individual burner, however, is still not uniform. There is severe flow distribution patterns picked up both by visual observations from the side ports and at the scanners, as well as by air flow balancing test results (reference RJM test report). This is an air flow distribution problem with the ductwork configuration.

2. Scanner Operation- Scanner adjustments as well as minor burner register setting adjustments were required after the outage to ensure flame stability (conducted during Turndown Testing immediately following the Outage).

Initial burner register settings were compromised to some degree to ensure that scanners saw flames at the scanner head location. The perimeter air loading problem needs to be resolved to eliminate this problem. Relocation of scanners to the outer zone should be considered to improve scanner performance.

3. NOx Levels- Indications on NOx levels are that there has been no appreciable change in emissions. This is based upon comparisons with before the Outage and on information on Unit 1. Additional detailed testing is required to evaluate more closely and to determine if there has been any overall improvements (comparison with a baselines).

Reference enclosed graphs showing Continuous Emissions Monitoring (CEM) NOx levels on both units over the last four months.

4. LOI Levels- Indications on LOI levels are that there has been no appreciable change. This is based upon comparisons with Unit 1 and from information gathered from before the Outage. Additional detailed testing is also required to evaluate more closely.

Monitoring will continue with Pozzolontic (fly ash sales contractor). Reference enclosed graphs showing fly ash LOI's on both units over the last four months.

5. Eyebrows- Unit 2's eyebrows are less severe than those on Unit 1's (based on operating time to date). Improved flame shapes seem to have helped this situation. However, due to some of the low ash fusion temperature coals, one would always expect some degree of eyebrows.

6. Burner Front Temperatures- An improvement of 100 F on maximum burner front temperatures has been realized in a typical configuration (based on Pulv 2H O/S). This maximum temperature reduction was the primary objective of the stabilizers and air flow balancing for out of service burners.

AGASS testing (controlled test conditions) will give more accurate detailed information on overall temperature improvements in all eight pulverizer configurations. Overheat temperature conditions are monitored at the outer air register backplates.

7. Cooling Air Flow Requirements- Converse to the burner front temperature reduction, windbox damper positions could be reduced by about 32% (from 51.0% to 18.9%, 2H pulv O/S). One would realize a reduction in cooling air flow requirements to a row of burners that are out of service (O/S).

Reducing windbox damper positions would reduce cooling air flow (which effectively acts like casing leakage) and puts the air requirements in the combustion zone where it is needed.

A compromise between a realistic maximum burner front temperature (1200 or 1250 F versus 1350 F) and acceptable cooling air flow requirements need to be worked out. This will require detailed testing and a controls modification for windbox damper positioning on each burner row.

8. Fuel flow balancing- Based upon station O2 instrumentation, oxygen profiles (deviation of O2 levels from probe to probe) across the eight economizer probes have been slightly improved. AGASS testing which looks at a 56 point grid at the same location as the station instrumentation will give much more accurate and detailed results.

Drum level which is direct indication of heat input from the burners, has also experienced an improvement. After unit startup, the three drum level transmitters (end, center, end) were much closer spaced in their level indication. Over time, however, furnace slagging and eyebrow formation plays a larger role in heat absorption and drum level deviations.

9. Secondary Air Flow Balancing- Testing completed during the end of the Fall '91 Outage, showed a 29% improvement in burner to burner balancing. Perimeter loading, however, around the burner shows severe imbalances. Reference enclosed RJM ADA Test Report and recommendations.

10. Boiler Performance- If cooling air flow requirements were reduced, an improvement in boiler performance could be realized. Additionally, with well balanced combustion (fuel and air flows), a reduction in excess air levels could be made which would also have significant positive impact on boiler efficiency.

11. Mechanical Integrity/Life of Stabilizer- The mechanical integrity of the flame stabilizer is undeterminable at this time. This item requires an outage for a fireside inspection to determine any mechanical problems with the stabilizer.

12. Life Extension of Burner- The flame stabilizer effects on the life extension of the burner itself is also undeterminable at this time. This item also requires an inspection to evaluate the actual impact on the burner integrity.

BURNER MODIFICATIONS

SUMMARY OF PROPOSED RECOMMENDATIONS:

UNIT 1 BURNERS-

1. New Designed Burners (48)
   New burners are currently being fabricated by B&W
   Installation is scheduled for the April 13, 1992 Outage

2. Flame Stabilizers-
   Fabrication (RJM)
   Recommended installation on Unit 1 (with mods)
   IPSC will submit purchase requisition and specifications.
   Budget Funding- IGS91-03, LADWP-PD&C has lead assignment.

   Installation (B&W, T&B or others)
   IPSC will submit purchase requisition and work scope for bid

3. Air Distribution and Balancing (RJM support)
   IPSC will submit purchase requisition and specs.
   Schedule four days of testing and balancing to end of outage (baseline test and three iterations).

4. Coal Pipe Restrictors
   IPSC will submit PR and specs for fabrication
   IPSC will submit PR and work scope for installation (B&W or T&B)

5. 3-D Modeling of Boiler Ductwork for Sec Air Flow Balancing
   IPSC will submit PR and specs
   RJM or B&W

6. Ductwork Modifications (based on results of 3-D modeling)
   B&W or Outside Contractor

UNIT 2 BURNERS-

1. New Designed Burners (48)
   Based upon evaluation of Unit 1's burners (min six month period with inspection outage)
   Installation scheduled for ??

2. Ductwork Modifications (based on results of 3-D modeling)

3. Additional coal pipe restrictor changeouts

PROPOSED BURNER MODIFICATIONS ON UNIT 1:

The following modifications are proposed for the combustion system on Unit 1.

NOTE: Unit 1 will have newly designed and fabricated burners.

1. Flame Stabilizers-

   a. Fabrication by RJM

   b. Modifications to B&Ws new burner design- Who (when, where) will cut off the inner air sleeve and lighter shroud plus attachment of the Flame Stabilizer to B&W's burner assembly.

   Additional Modifications to Stabilizer:

   c. New Swirl Number Calculation- RJM to calculate a new swirl design value based upon experience gained from Unit 2's burner.

   d. New Inner Diameter Dimension- With new burners the inner diameter tolerance could be lowered.

   e. Lighter Shroud Diameter Increase- Due to concerns with lighters drooping Unit 2's diameter should be enlarged.

   f. Scanner Opening- There is a possibility of relocating the scanner opening into the outer zone (vs inner) for flame scanner improvements. This would eliminate the large inner zone opening. Consequences however, for the scanners not functioning properly (in all cases) in the outer zone would be serious. Would require outage and field cutouts of holes in inner zone (fireside picks).

2. Air Distribution Analysis (Baseline and Balancing)- Recommend baseline and balancing air flow testing to set shrouds and backplates positions to equalize air flow distributions through the burner.

3. Coal Pipe Restrictor Installation-

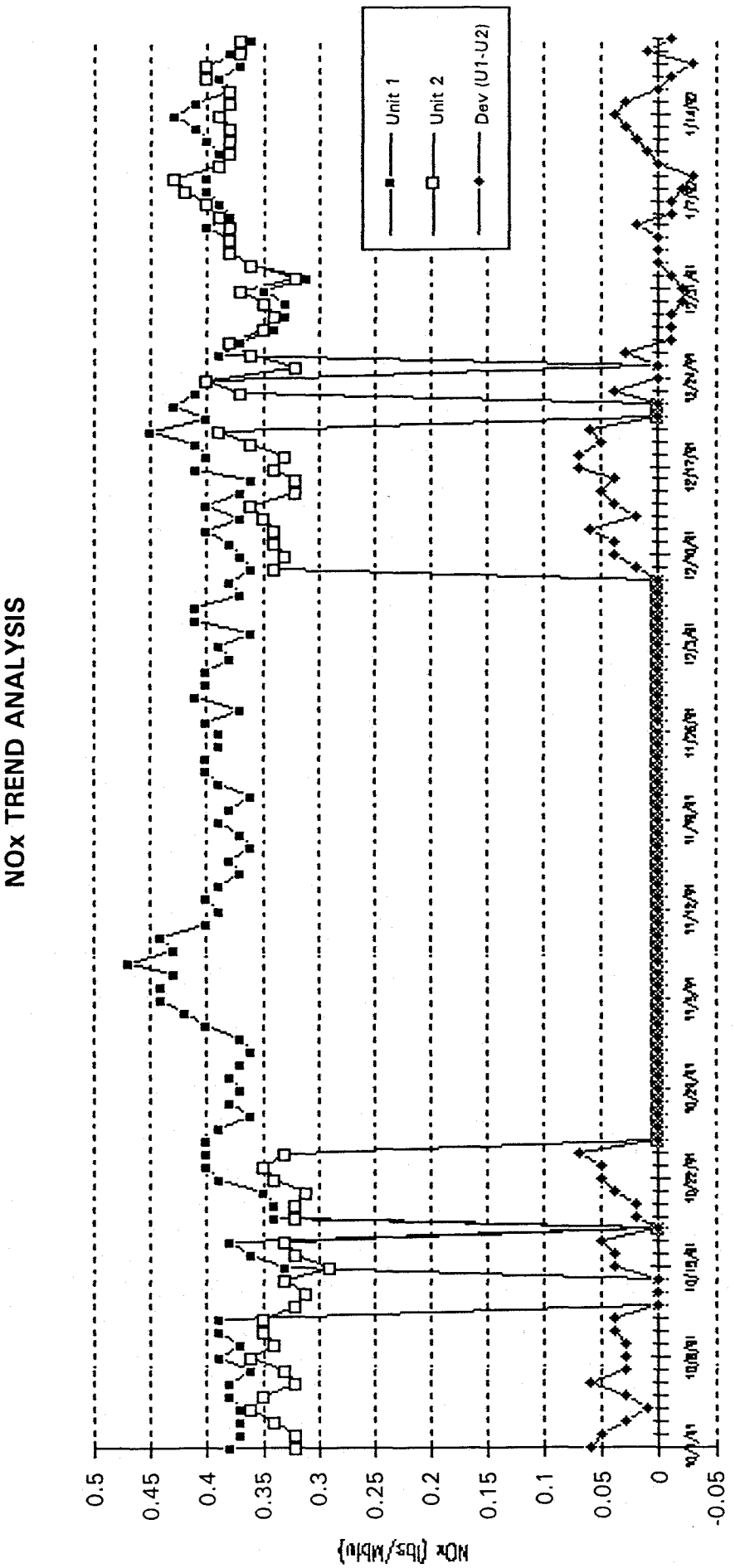
   a. Retesting Unit 2- Scheduled
   b. Modifying Unit 2 nozzles for Unit 1- In house or send out.
   c. Installation IPSC or Contractor- IPSC Maintenance

doesn't want to do installation because it would slow them down on pulverizer overhauls.

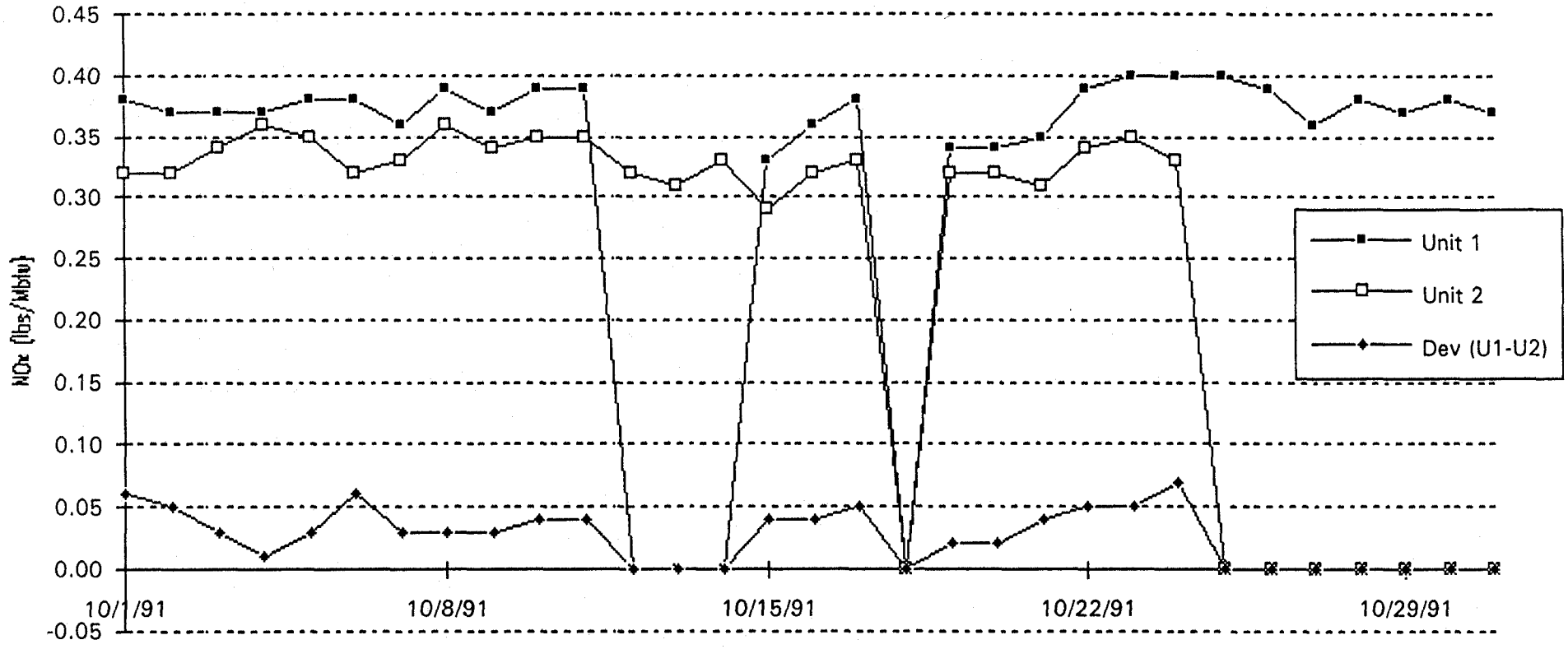
4. Three Dimensional Analysis- This analysis is required to address air distribution problems associated with secondary air duct configurations. The analysis is a mathematical model from the air heater outlet to furnace outlet.

   This item needs to be seriously considered. Please review RJM report and final recommendations. Note, this can also be justified in lieu on additional air flow monitoring instrumentation.

5. Ductwork Modifications- Air flow distribution problems can be corrected by straightening vanes, turning vanes, vortex breakers or other obstructions added to the ductwork. RJM would like to conduct a model to locate and size these items. B&W, however, states they can locate and install these without analysis (barnyard?).


NOx TREND ANALYSIS
NOx (lbs/MBtu)
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
Unit 1
Unit 2
Dev (U1-U2)

NOx TREND ANALYSIS (Before Outage)



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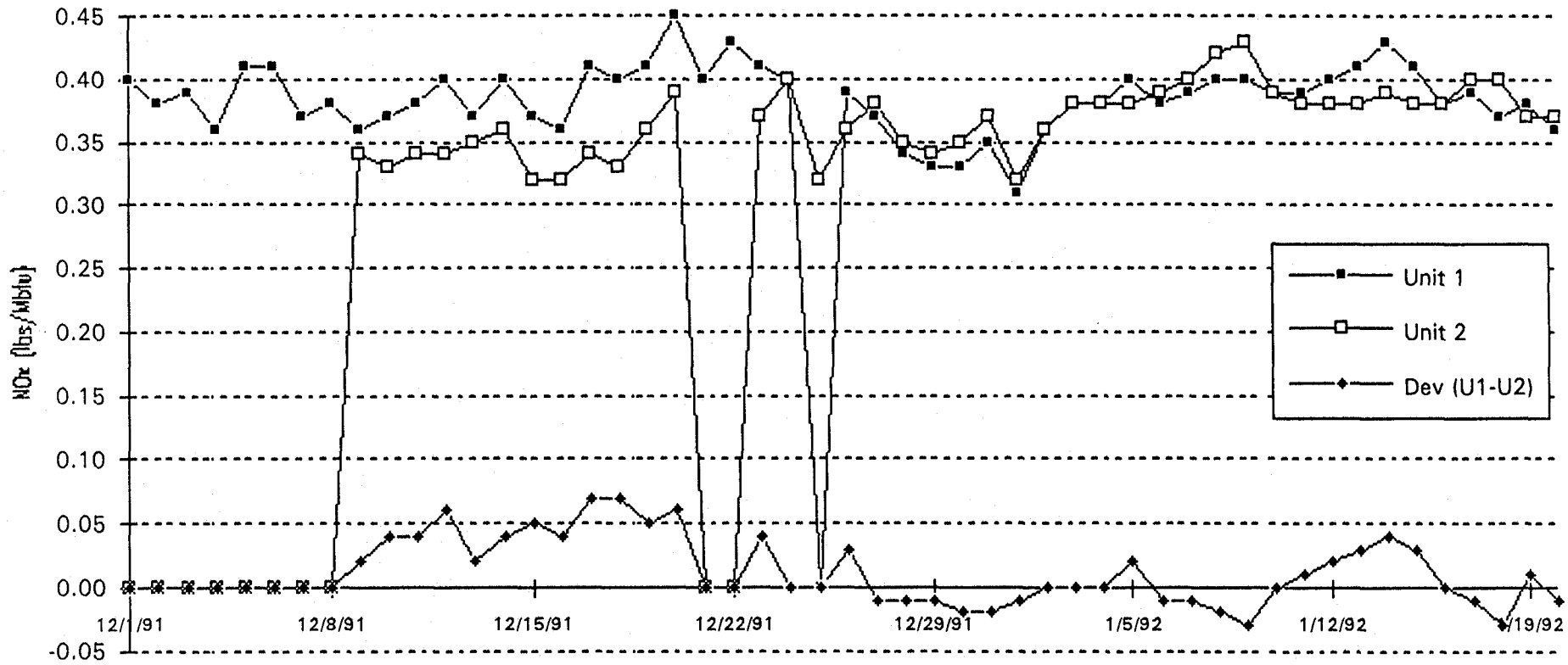
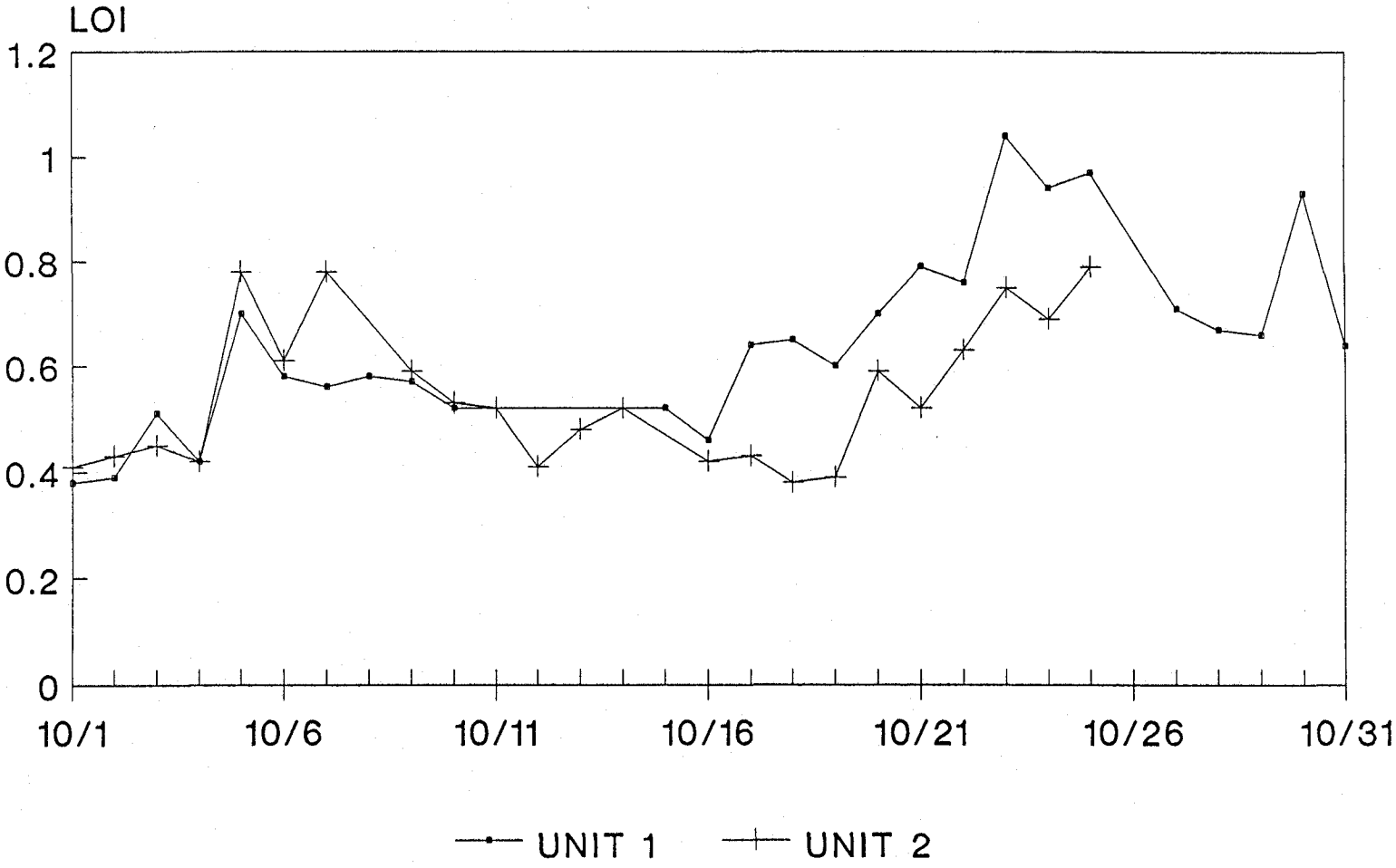


DELTA ASH LOI
TOTAL AVERAGES - OCTOBER 1991



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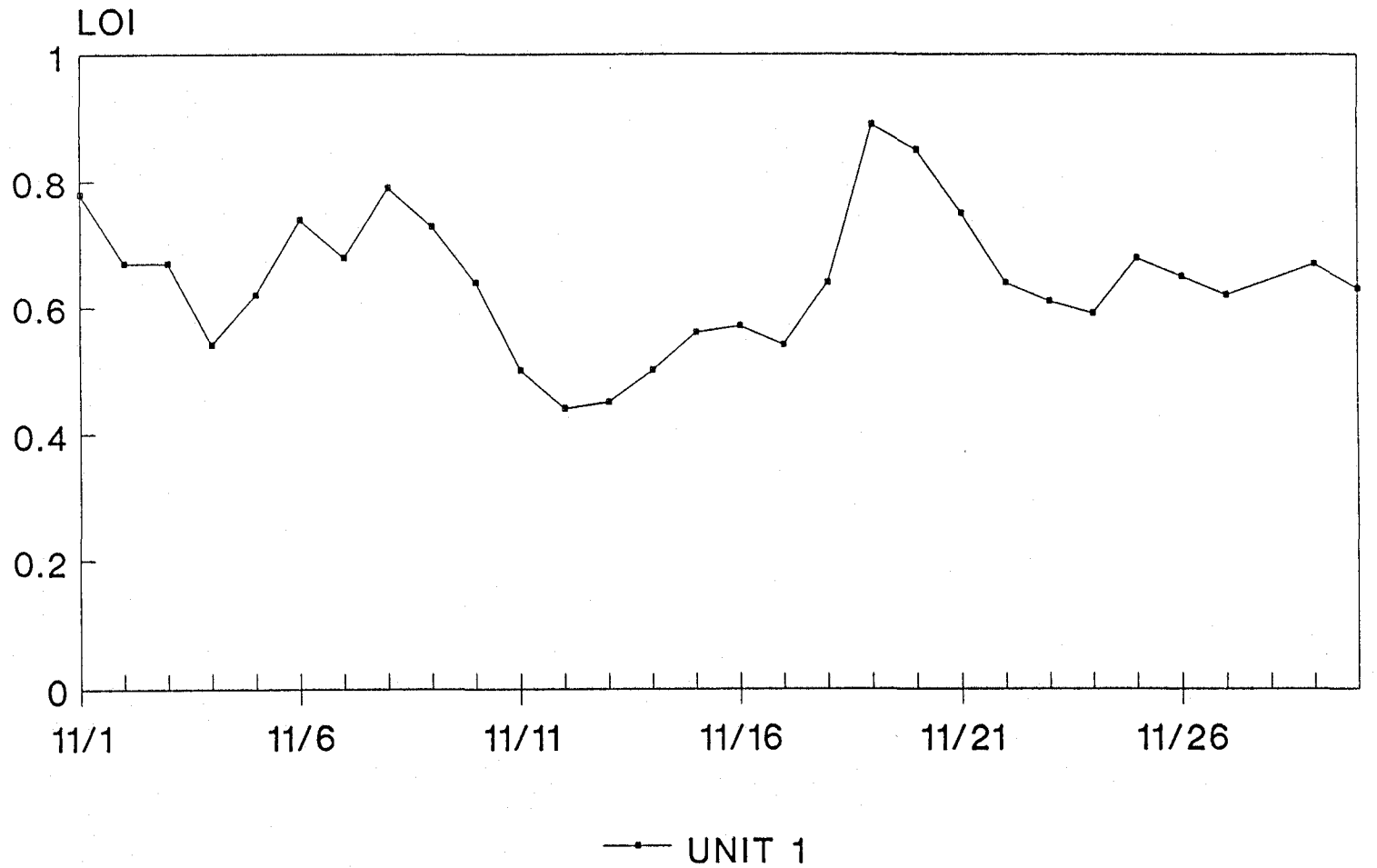

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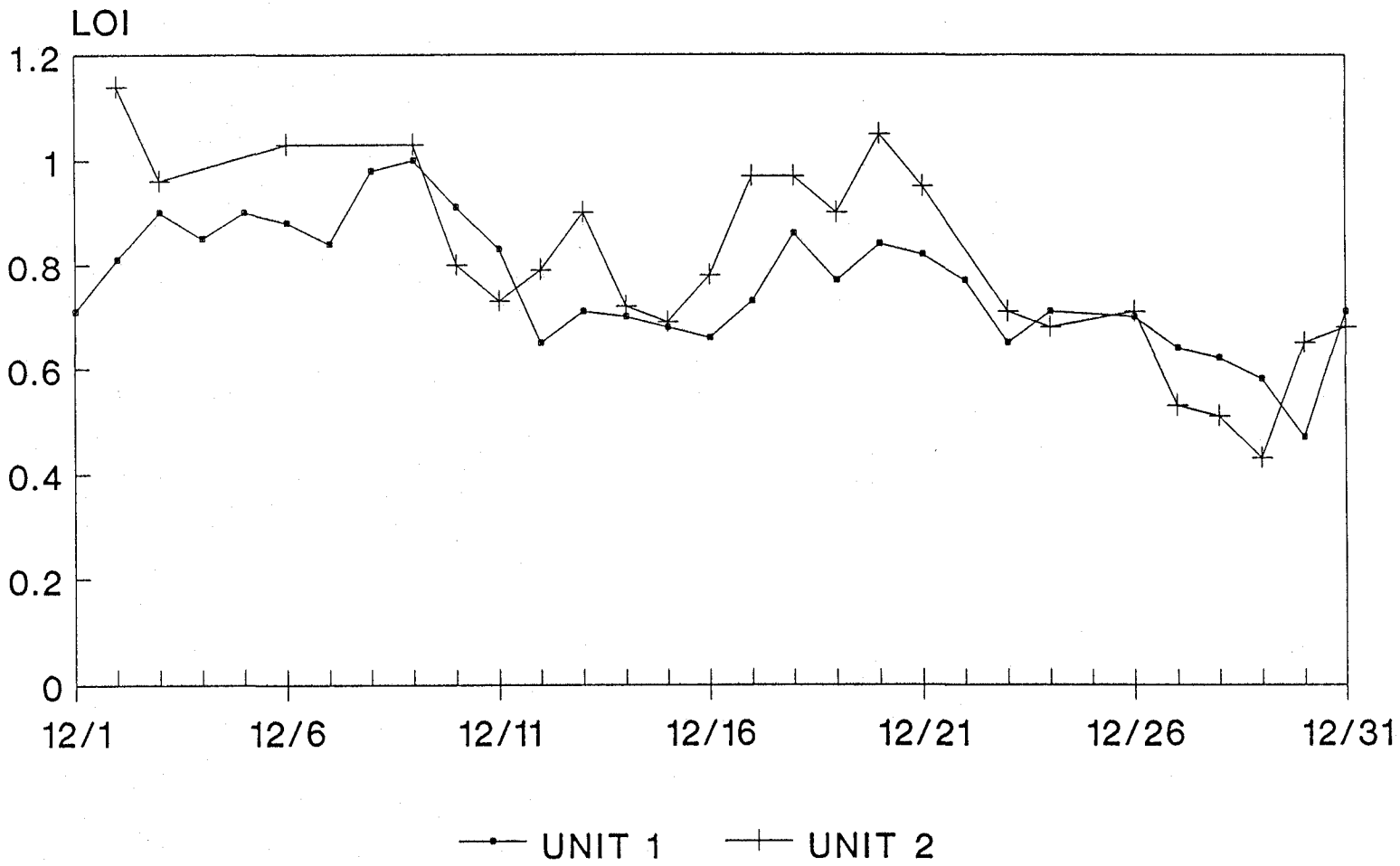
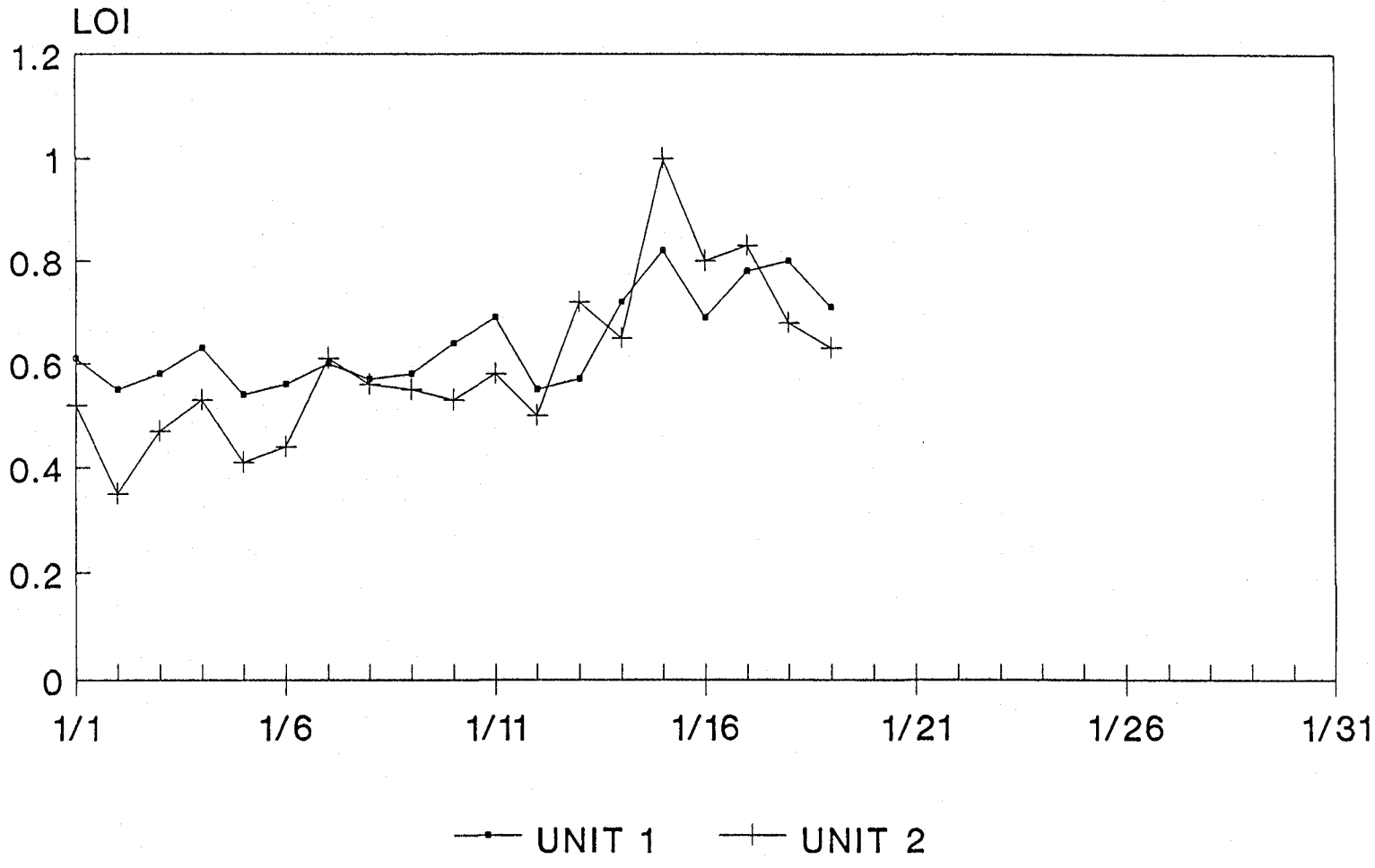
DELTA ASH LOI
TOTAL AVERAGES - DECEMBER 1991



DELTA ASH LOI
TOTAL AVERAGES - JANUARY 1992



Burner Front Temperature Analysis (Based upon typical operating conditions)

IGS UNIT 2 1/24/92

	Case 1: Before Flame Stabilizers	Case 2: After Flame Stabilizers
Average Operating Conditions:		
Date:	10/16/91	12/10/91
Load (MWg)	842.2	840.6
7 mill operation, Pulv ?? out of service	2H	2H
Total Air Flow (%)	74.2	74.7
Excess Air (%)	3.42	3
Total Fuel Flow (TPH)	329.7	326.2
O/S Windbox Damper Position:	51	51

BURNER FRONT TEMPERATURES (F average)

	Burner Number							
H Burners O/S	1	2	3	4	5	6	Maximum	Average
W/O Stabilizers	1037	1066	1152	1291	1141	1066	1291	1126
W/ Stabilizers	955	1128	1079	1194	1140	1128	1194	1104
Overall Temp Improvement							97	22